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TITLE: PNEUMO MSG-325 LATHE

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MASTER

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UNITED STATES
DEPARTMENT OF ENERGY

PNEUMO MSG-325 LATHE

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The LASL Shop Department has recently installed a Pneumo MSG-325 two-axis contouring lathe. This one-microinch resolution lathe, which utilizes both air-bearing spindle and air-bearing slide ways, was purchased primarily for miniature work, but can also single point diamond turn metal optics.

The need for highly precise miniature parts with optical quality surface finishes has lead the Los Alamos Scientific Laboratory's Shop Department to purchase a Pneumo MSG-325 two-axis contouring lathe. This lathe is controlled with an Allen-Bradley CNC control unit and utilizes a Hewlett-Packard laser interferometer system for one-microinch resolution feed-back. The lathe has air bearing slide ways with 300 by 200 mm travel.

The lathe was specified to allow parts in the sub-millimeter size range, such as needed for inertial confinement fusion targets, to be turned. A scale model analysis of a typical machining process was used to aid in the machine specifications.[1] In general we sought a lathe with the ability to precisely move in 0.1 micrometer or smaller steps, with the capability to single point diamond turn and with the adaptability to hold miniature parts. Pneumo Precision, Inc. of Keene, New Hampshire manufactures the MSG-325 lathe, shown in Figure 1, primarily for the single point diamond turning of metal optics, but the lathe has met our requirements for the very small parts. In addition to these very small parts we intend to make a variety of precision parts up to about 100 mm in diameter as well as possibly turning some optical components.

Some details of the machine parameters are shown in Table I. The air-bearing ways are attached to a large granite block which is supported inside the outer frame on a three point, self-leveling air isolation system. The size of the granite base can be seen in Figure 2. The air-bearing spindle is driven with a vibration isolated motor mounted on top of the spindle housing utilizing a thin flat belt. The laser interferometer components are mounted to a frame attached to the granite base. The spindle drive and laser brackets can be seen in Figure 3, a photograph of the machine with the motor cover removed.

The lathe (approximate cost, $300,000) was purchased to detailed LASL specifications. Acceptance testing was performed at Pneumo's plant. The specifications and test results are summarized in Table II. The machine met all of our specifications prior to shipping to LASL, although the positioning checks were somewhat inconsistent (judged by the LASL representative to be due to temperature variations at the Pneumo plant). The straightness checks were performed by using Pneumo's quartz straight edge, and the positioning checks were against a Moore 18 inch step gage supplied by LASL. A typical straightness check is shown in Figure 4.

The machine was ordered in August 1979 and delivered to LASL in June 1980, approximately one month earlier than scheduled. Two representatives from Pneumo accompanied the machine and directed the installation. The machine was installed and operating on the fourth day after arriving at LASL. The machine has performed very well, and we plan to move it into a room with temperature control in October or November 1980.

A test part was designed with some of the characteristics of the small parts intended for this lathe. The part contains a conical section and transition to a spherical end radius as shown in the sketch, Figure 5. A photograph of a copper and brass part turned on the Pneumo lathe to these dimensions is shown as Figure 6. The internal linear and circular interpolation of the Allen-Bradley controller was used to generate the contour.

The surface finish appears very good visually and a Proficorder trace of the conical section of the copper piece is shown on Figure 7. The part was machined at 2000 rpm using a 0.020 inch radius diamond tool with a feed rate of 0.100 inch per minute.

One area of this part which is of particular interest to us is the smoothness of the transition between the conical section and the spherical radius. We have examined this transition by using a 0.0005 inch radius stylus in our linear Proficorder passing over the part parallel to the conical section. This record along with plotted theorectically perfect points is shown in Figure 8.

This part illustrates that the machine is capable of doing many of the small contoured shapes we require at LASL. A good deal of work remains in designing the special fixturing and tooling often required for the special small hardware pieces, but we think the Pneumo lathe performs very well and has a great deal of potential in the area of ultra-precision turning.

References

1. R. L. Rhorer, "Machine Tools for ICF Pellet Fabrication" Los Alamos Scientific Laboratory informal report LA-UR 79-2646 (February 1980).

TABLE I

[illegible]

Z-Axis Travel (Spindle Slide)	500 mm
X-Axis Travel (Tool Slide)	200 mm
Part Diameter Swing	Approx. 300 mm
Spindle Weight Capacity	500 pounds
Spindle Drive	DC Motor & Flat Belt
Spindle Speed Range	100 to 2400 rpm
Programming Resolution	1 microinch
Feed Rate Maximum	4 inch/min
Controller	A-B 7360
Laser Interferometer	H-P 5501 (Manual Compensation)
Slide Drives	DC Motor & Ball Screws
[illegible]	[illegible] System
Machine Weight	Approx. 12,000 pounds
Air Requirements (Spindle & Slides)	40 SCFM @ 90 psi

TABLE II

[illegible]

	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
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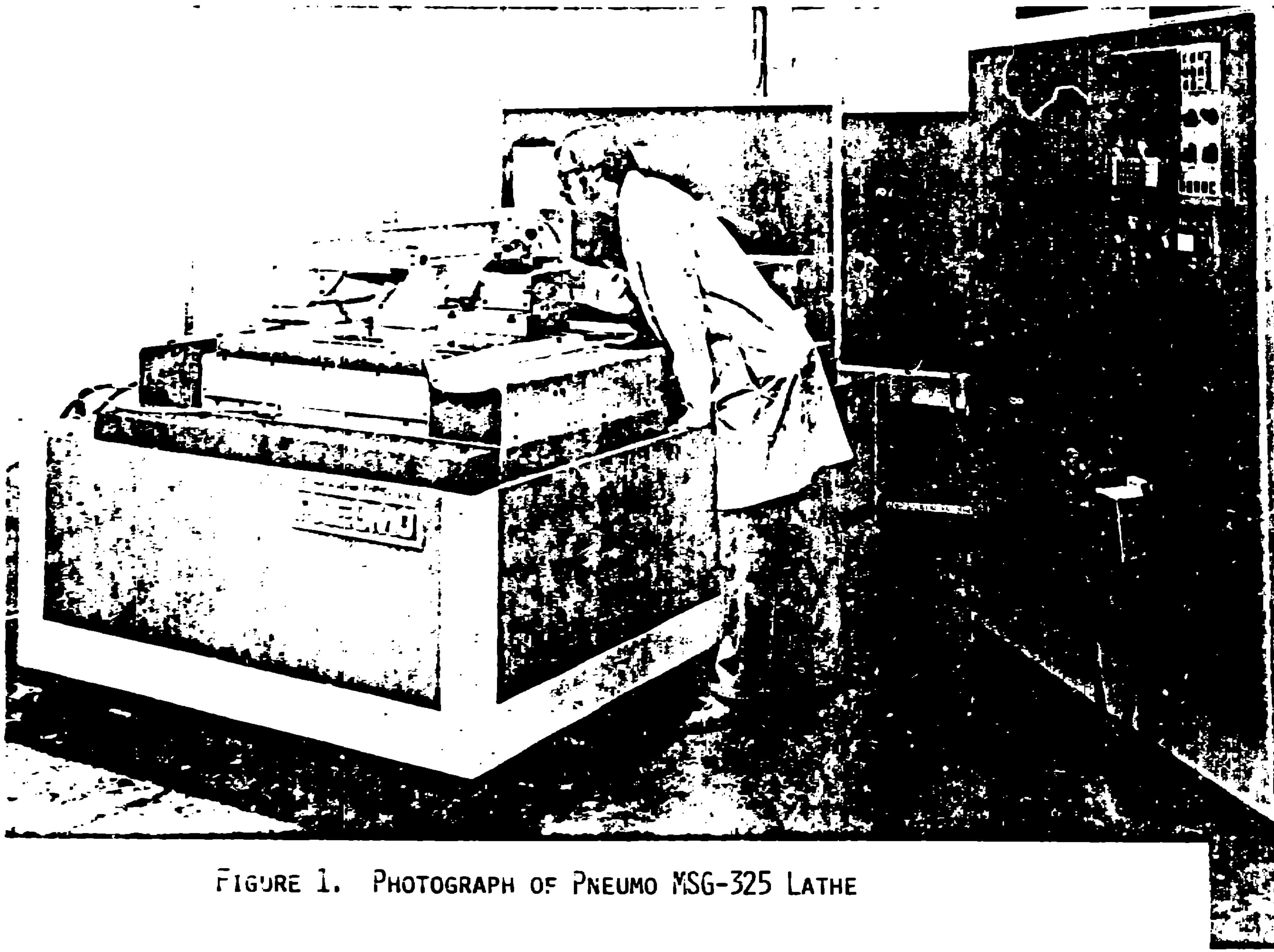

Figure 1. Photograph of Pneumo MSG-325 Lathe

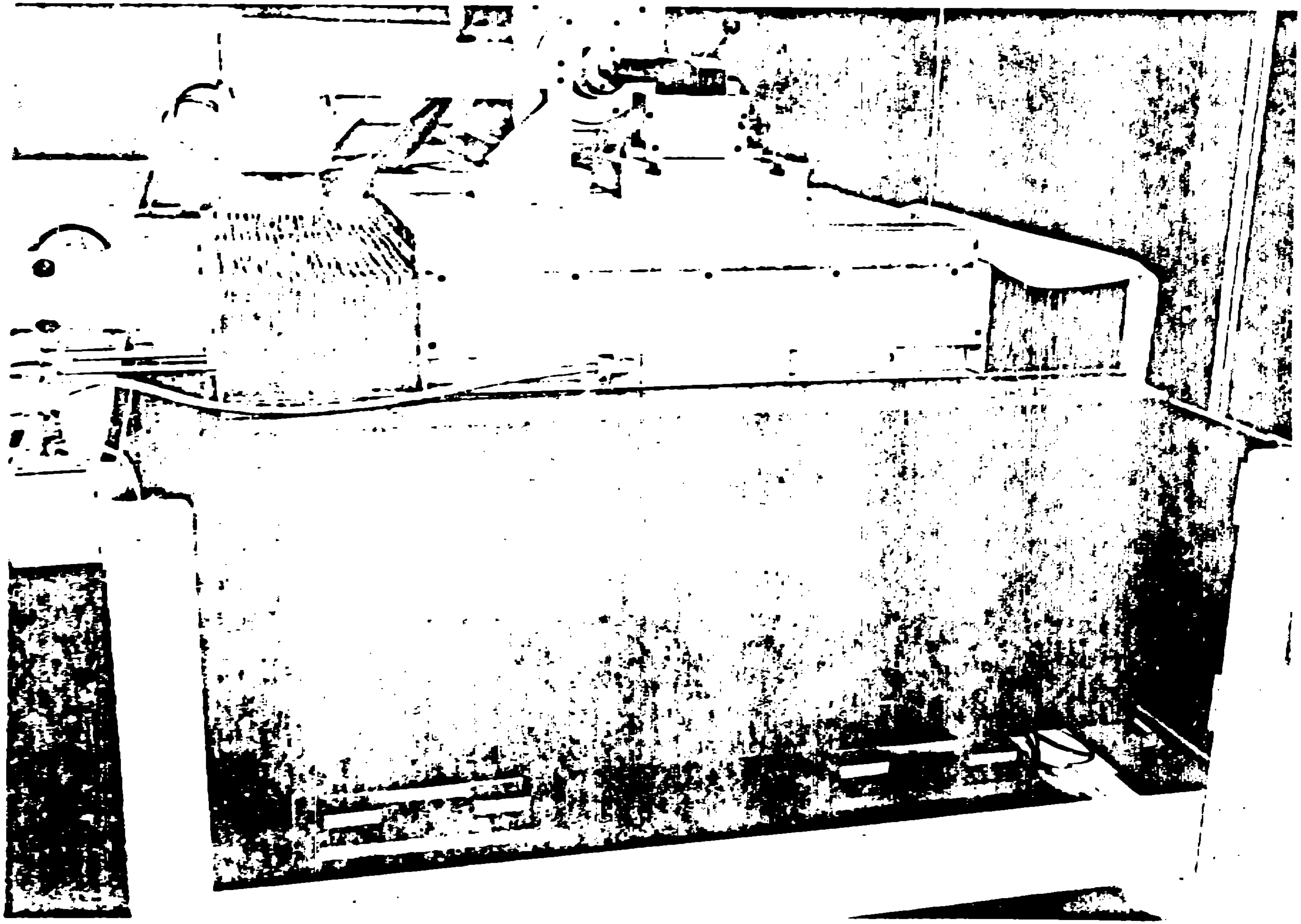

FIGURE 2. GRANITE BASE OF LATHE

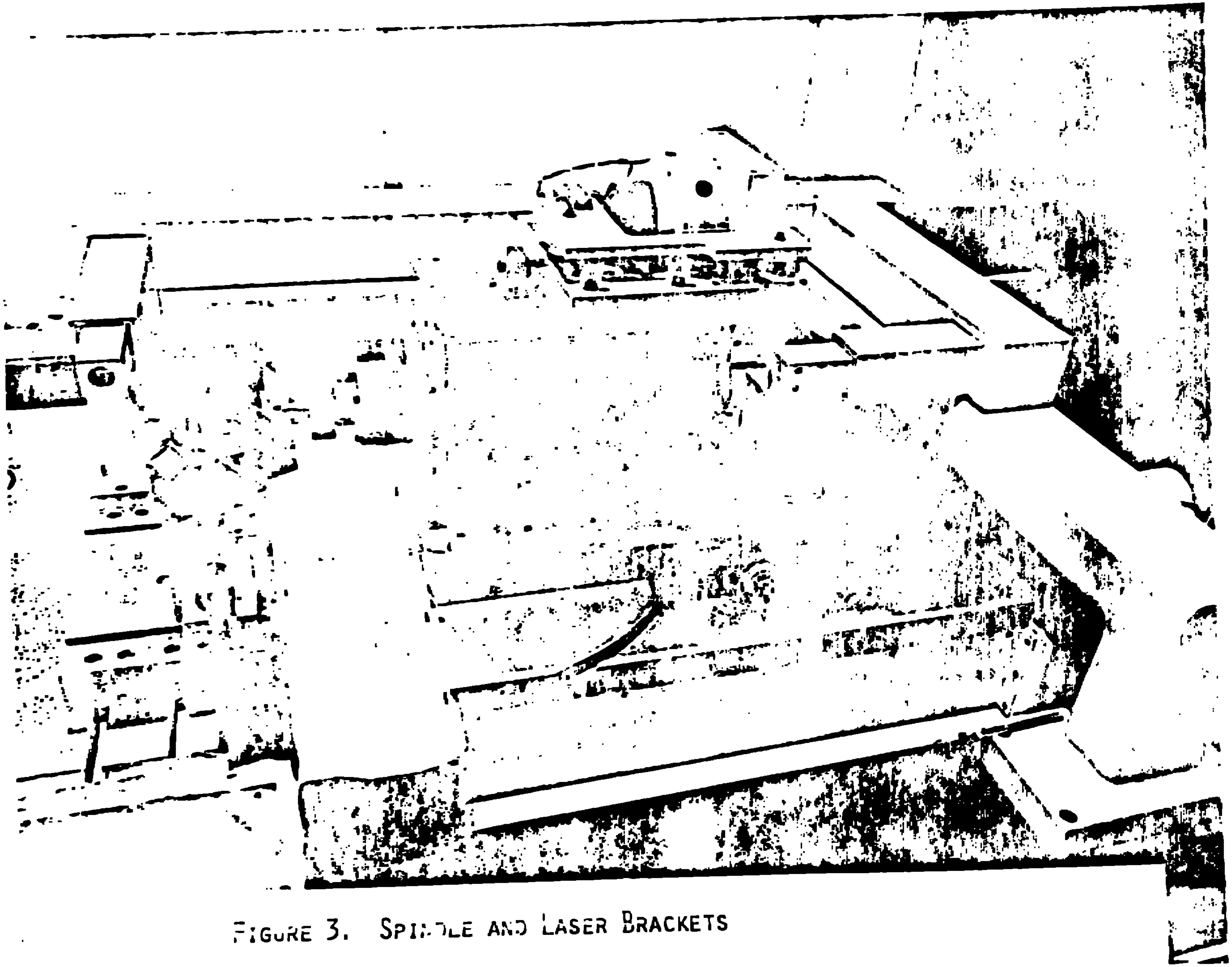

FIGURE 3. SPINDLE AND LASER BRACKETS

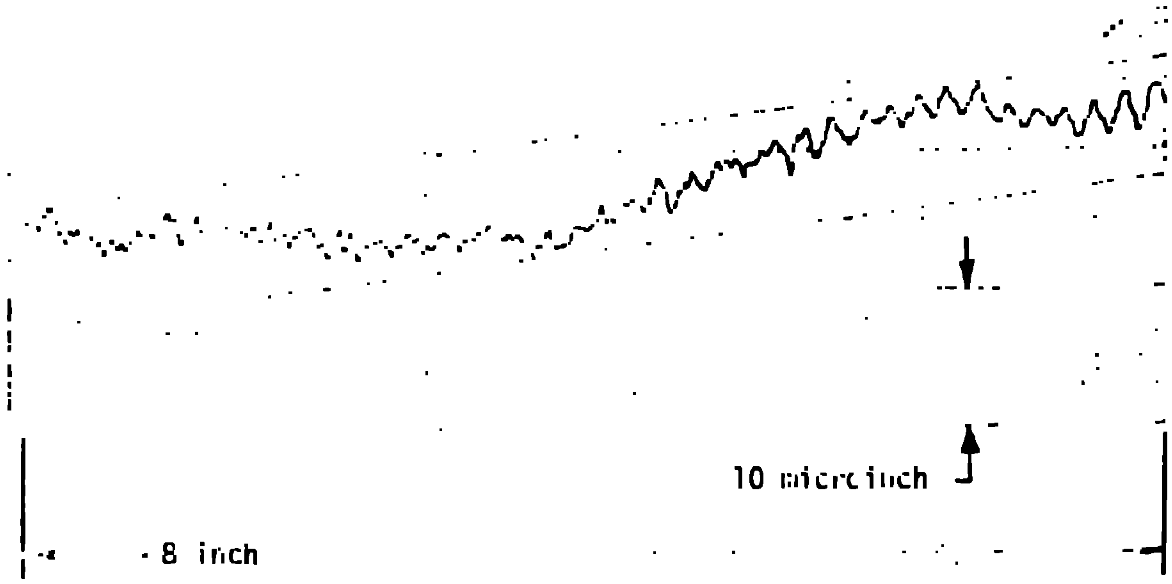

Figure 4. Horizontal Z-Axis Straightness Test

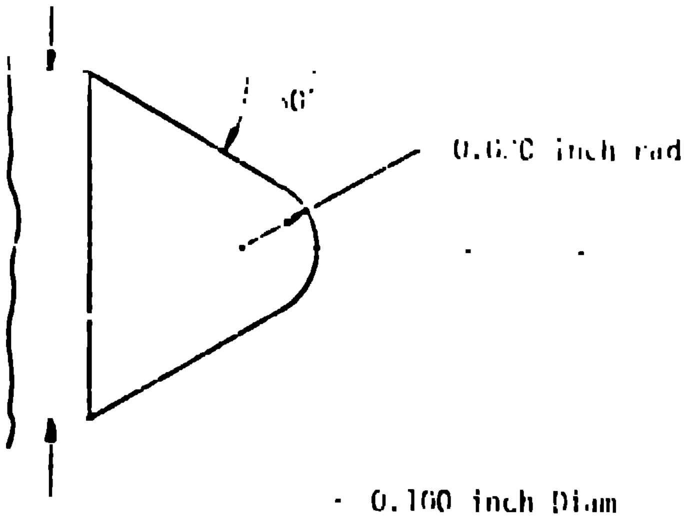

Figure 5. Pneumo Lathe Test Piece

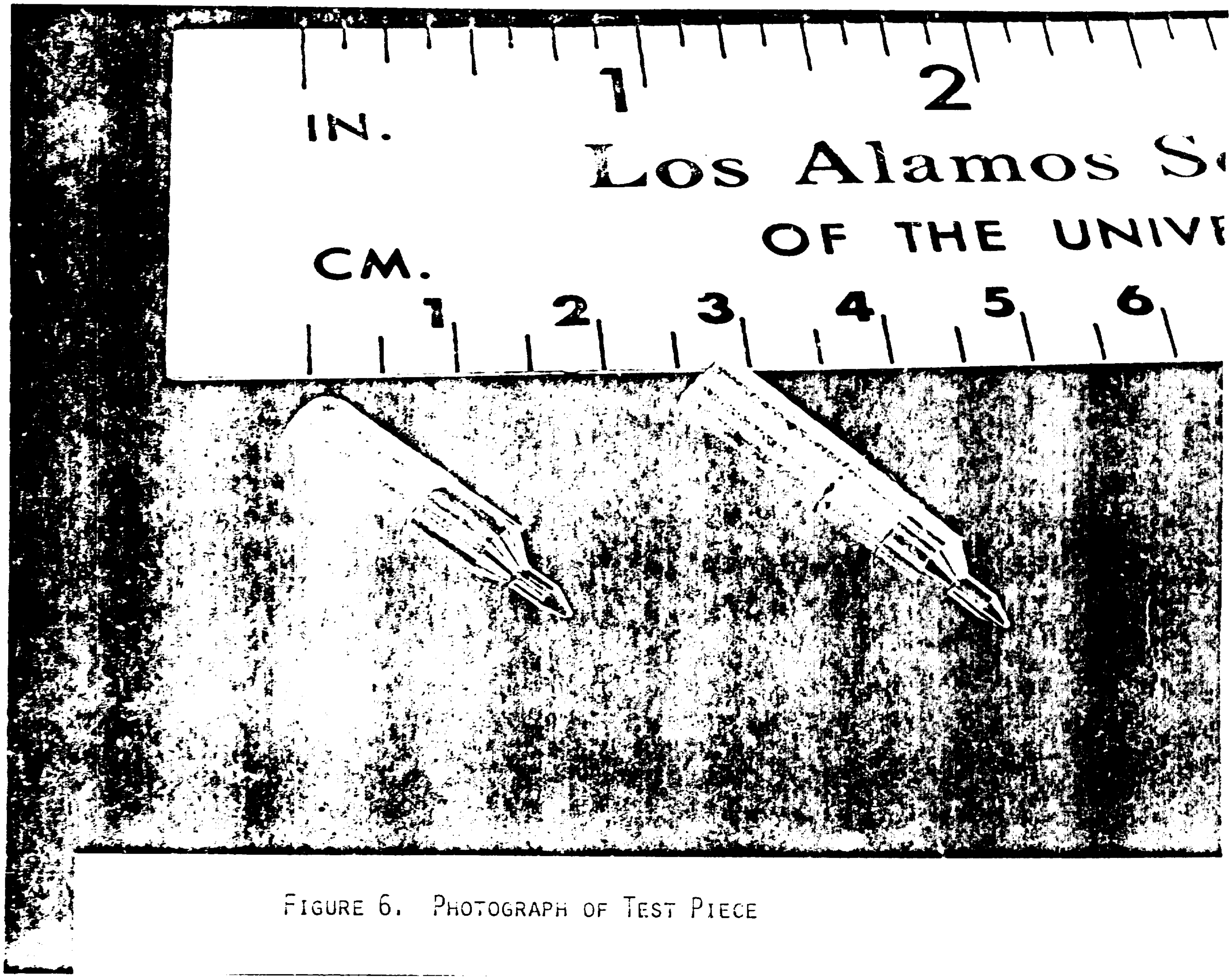

FIGURE 6. PHOTOGRAPH OF TEST PIECE

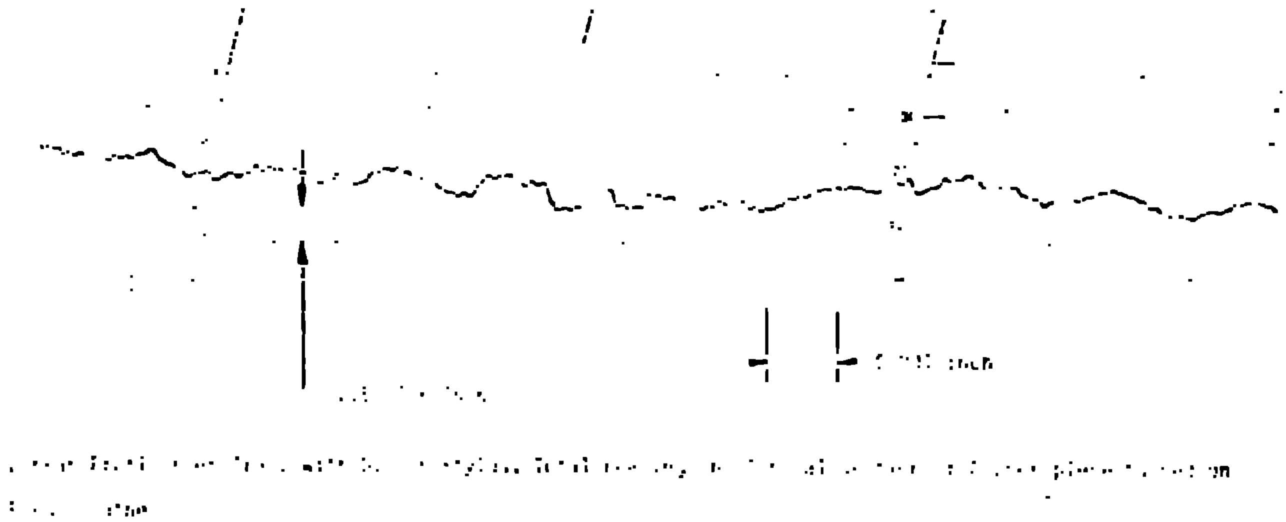

Figure 7. Surface Finish of Test Piece

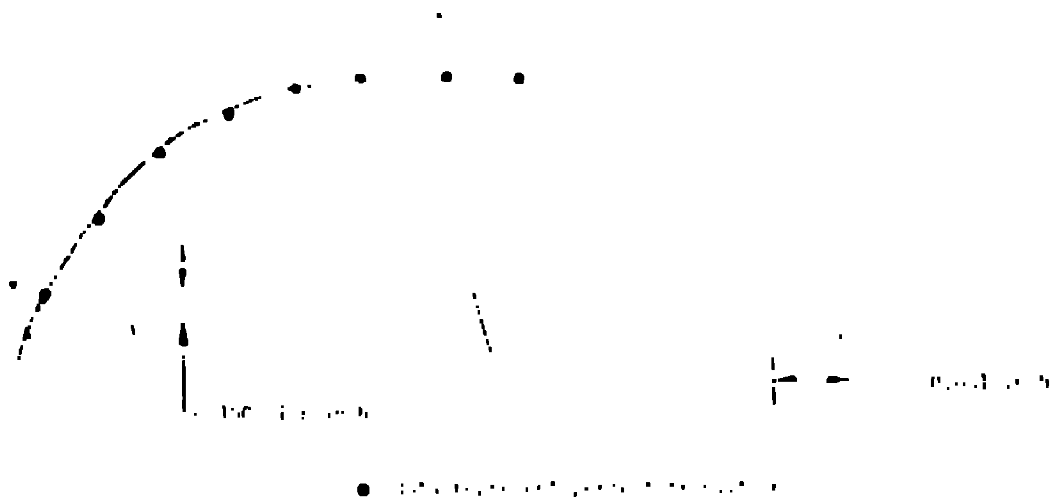

Figure 8. Transition of Cone to Spherical Section